

Status Checking System of Home Appliances Using Machine Learning

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Abstract: In these papers describes status checking system of home appliances based on machine learning, which can be applied to existing household appliances without networking function. Designed status checking system consists of sensor modules, a wireless communication module cloud server, android application and a machine learning algorithm. The developed system applied to washing machine analyses and judges the four kinds of appliances status such as staying, washing, rinsing and spin-drying. The measurements of sensor and transmission of sensing data are operated on an Arduino board and the data are transmitted to cloud server in real time. The collected data are parsed by an Android application and injected into the machine learning algorithm for learning the status of the appliances. The machine learning algorithm compares the stored learning data with collected real time data from the appliances. Our results are expected to contribute as a base technology to design an automatic control system based on machine learning technology for household appliances in real time.

I. Introduction

Most of the electronics equipment and devices can communicate with user and other things and these communications and its services among things are referred to as Internet of Things (IoT). The user and things can get information about the equipment and control the equipment through the various communications technologies. Although IoT technology is rapidly advancing, but the application of IoT technologies to the traditional home appliances is a little bit slow in progress. Many of the existing home electronics appliances are not still connected to internet Washing machine as an experimental subject to develop a status checking system based on machine learning. Especially washing machines in launderette are shared with other people who want to do the wash need to know when the washing will be ended and which washing machine is available for use to save their time and considerate of others knowledge.

II. Headings

1) parse web servers

The system introduced in this paper operates based on data communication with smart phone, data server and Arduino board. The server is Parse.com web server and the Parse.com provides proper APIs for android and Arduino. The web server is based on text data sheet format, and data requesting and saving actions are convenient by using the APIs. In this system, because the main data which are transmitted from Arduino to server are float format such as vibration data and current data, the Parse.com web server is proper to implement this system

2) WEKA Machine Learning Program

The Waikato Environment for Knowledge Analysis (WEKA) program is machine learning software developed by university of Waikato, New Zealand. Developers can choose a proper machine learning algorithm and modify the algorithms for their purposes as open source software. Because the software is developed using java code, it is compatible for android system by making the software library form.

3) RBF network algorithm

Radial Basis Function (RBF) network is one of the artificial neural network logic. The main feature of this algorithm is effect between input sources. all of the input sources effect to all of the radial basis functions with each weights of input sources and the radial basis functions effect to the one output with linear weights. Because of the feature the RBF network has advantage not only in nonlinear system also linear system to derive a specific output by allocating independence weights to each input sources is expressing the probability distribution of two functions with equal value of weights in RBF network. In the system which is introducing in

this paper, because the washing machine has four states of output such as staying, washing, rinsing and spinning the functions should be four with equal weights and probabilities.

III. Methodology

1. System Design

The data which transmitted from Arduino are accumulated in the server divided with learning data and real time data. The divided data are accessed by smart phone in the process. When user requests current status of washing machine the application accesses the server and request learning data and real time data. And then, in the process 3, the data are injected machine learning to determine the current status of the washing machine. At last the machine learning returns result to the application and the application displays the result.

2. Arduino

We should create sensor that can extract data about four states of machine and we should create transmission system that can send the sensor data. First it should needs basic three buttons. One of them is stop button to avoid extracting wrong data from unpredicted situations that generate error. We use yellow LED to distinguish whether the stop button is on or off. If the yellow LED was on, the system is stopped. Another button is separating with testing data and learning data. It is also expressed by red LED and green LED. If green LED is on the Arduino is extracting testing data. And red LED means extracting testing data.

3. Android and machine learning

The android has a button for requesting the status. In the of this capture of display is showing the status of rinsing. In the android application, there is determining logic with a WEKA machine learning algorithm library. We choose a machine learning algorithm as the RBF network model which has some advantages in non-linear system because we cannot assure that the sensor data show the linear trend at the moment of status change. This algorithm is simplified by allocating equal weight to each statuses and equal probability to 1. Because the washing machine has four statuses, the graph should be expressed with four functions. In the graph, y-axis means the probability of each status and x-axis means RBFs. When the RBF network learned from learning data, each statuses are defined 0, 1, 2 and 3 and determine the status by the probability of each RBFs. The x-axis value divide with 0.75 gaps between each function and the boundaries on 0.75, 1.5 and 2.25 are standards of determining status in this algorithm.

4. Server

In the server, there are two kinds of data storage as learning and real time. The learning data storage has four columns which are expressing dates, vibration values, current values and status. And, the real time data storage has dates, vibration values and current values.

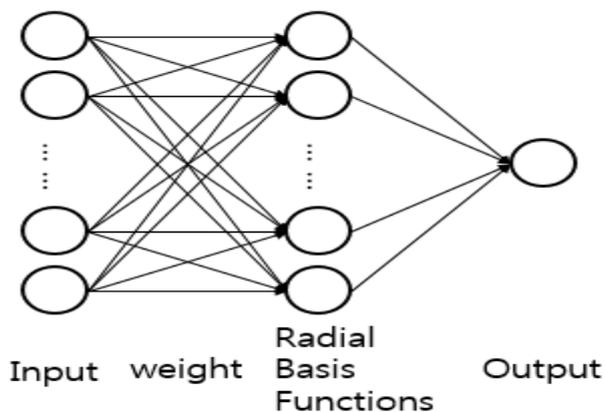
- (a) Full screen of web server page
- (b) Details in real time data

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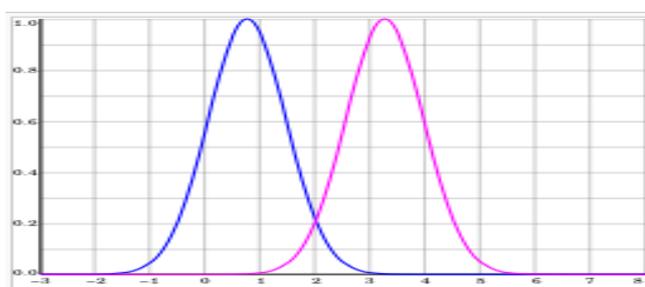
- (a) Current sensor values
- (b) Vibration sensor values

IV. Figures And Tables

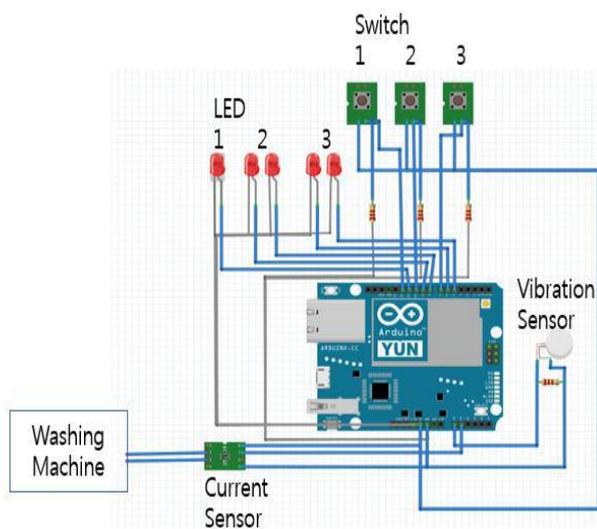
The Architecture of RBF Network Algorithm



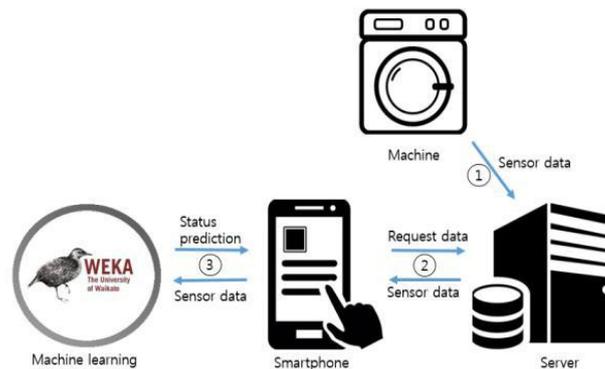
The Principle of RBF Network



The Arduino System Circuit



The Structure of System And Data Flow



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V. Conclusion

Many people could not experience the usability of the IoT technologies because of the high prices of the new home electronics appliances equipped with IoT technologies the system introduced in this paper provides a method that the new IoT technologies scan be applied to existing old-fashioned home appliances. These technologies can make home appliances automatic and it also can be used to other areas such as agriculture effective management system of industrial field if proper sensors are used and control software is developed for each application environments. In the transition phase of change to automation life, much research work on control technologies which can be applied to existing old fashioned devices is needed to develop high quality of automation systems.

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